UNITED STATES
ATOMIC ENERGY COMMISSION
OAK RIDGE OPERATIONS
P.O. BOX E
OAK RIDGE, TENNESSEE 37830

AREA CODE 615
TELEPHONE 483-8611

CR

IN REPLY REFER TO:

OSH:WTT

April 2, 1968

Cys fwd to:
J.A.Cox
D.E.Ferguson
J.H.Gillette
T.A.Lincoln,M.D.
K.Z.Morgan
F.R.Bruce

Please send any comments you have to F.R.Bruce by May 14.

Union Carbide Corporation
Nuclear Division
Post Office Box X
Oak Ridge, Tennessee

Attention: Dr. A. M. Weinberg, Director
Oak Ridge National Laboratory

Subject: ANNUAL HEALTH AND NUCLEAR SAFETY APPRAISAL OF ORNL

Gentlemen:

The annual health and nuclear safety appraisal of the ORNL facilities was conducted November 13-17, 1967, by members of the ORO Safety Division. The findings were informally discussed with your representatives at that time. A draft of the appraisal report was reviewed by the ORNL staff and comments returned informally to ORO.

Enclosed are six copies of the formal report of the appraisal. You may proceed with implementation of the recommendations unless there are sound reasons why they are not warranted. In any event, your comments with regard to the conduct of the appraisal, the general content of the report, and the detailed plans for implementing or otherwise handling the recommendations are requested by May 20, 1968.

The cooperation extended by members of your staff during the appraisal is appreciated, and we are pleased that the report reflects continued safe operation of the ORNL facilities covered by this review.

Very truly yours,

Herman M. Roth

Herman M. Roth
Director
Laboratory and University Division

Enclosure:
Appraisal Report (6)

CC: C. E. Larson, UCC-ND
R. C. Armstrong
J. D. Donovan
J. A. Lenhard

ORNL HEALTH PROTECTION APPRAISAL

NOVEMBER 1967

I. Purpose and Scope

The annual appraisal of ORNL health protection programs was conducted during the week of November 13, 1967, by members of the Health and Nuclear Safety Branch, Safety Division, ORO. This year's appraisal emphasized operations and health physics activities during the first year of TRU facility operation, environmental pollution sources and sampling, the industrial hygiene program, applied health physics field surveillance programs, nuclear criticality safety, and transportation of radioactive and fissile materials.

II. Summary

ORNL continues to maintain a highly responsible health protection program. Employee exposure to radiation and to toxic materials remains well within acceptable guidelines. Reaction of the ORNL health protection surveillance program to new and changing laboratory activities seems quite adequate. The status of air pollution control is considered to be acceptable relative to current and anticipated standards. The nuclear criticality safety control program continues to be maintained at a satisfactory level. While some problems were encountered with radioactive materials transport, ORNL continues to meet the intent of AECM-0529.

The report contains specific recommendations in the area of water pollution and industrial hygiene administration. Other findings of the appraisal are found in Section IV of the report.

III. Recommendations

A. The efficiency of the main sewage treatment plant should be determined as discussed in IV-B.2.

B. Clear guidance should be provided the industrial hygiene group to assure ORNL surveillance of CPFF contractor activities is satisfactorily complete as discussed in IV-A.

C. ORNL management should review the informal delegation of industrial hygiene responsibility for ORNL's Y-12 facilities to assure that their operations in Y-12 are, in fact, receiving adequate coverage.

IV. Findings

A. Industrial Hygiene

This group appears to be adequately staffed considering the magnitude of existing and foreseen ORNL programs. There was evidence of a high degree of cooperation between the industrial hygiene group and others. Efforts such as the lectures to Plant and Equipment Division groups, the preparation of "toxic guides," and the development of the relatively recent laser safety procedure indicate the industrial hygiene group pursues an adequate in-house education program. This group also operates an excellent respirator testing, fitting and repair facility resulting in a significant cost saving without compromising safety. From the data reviewed, personnel exposures to readily recognized industrial toxicants such as lead and beryllium appear to be under good control.

The potential for personnel exposure to cadmium from silver solder work needs further investigation. It is understood that a now-retired supervisor in the P&E Division began a study of silver solder (% Cd) to determine if satisfactory "welds" could be made using low or cadmium-free silver solder. When concluded, the results of this study should be quite helpful to the industrial hygiene group in attempting to determine the need for corrective action in terms of respiratory protection, ventilation or the use of low-cadmium or a cadmium-free silver solder. This study should be reactivated and completed. During this visit, a "toxic guide" for cadmium was near the final stage of distribution and should assist in alerting the using population to the potential danger.

From discussions at several management levels, it appears no clear guidance has been provided the industrial hygiene group concerning surveillance of ORNL CPFF contractor activities such as for Rust Engineering. This should be corrected to assure that ORNL discharges its responsibility in this area.

ORNL's oxygen deficiency surveillance program should be clarified as to the group having the responsibility and a formalized program should be developed. Although appropriate equipment is available and is used for such measurements, there appeared to be no formal program to assure the existing practice is adequate.

Despite the fact a comprehensive laser safety procedure has been issued, there are apparent inconsistencies in the safety precautions as applied at the X-10 and Y-12 sites. It is understood that the responsibility for industrial hygiene surveillance of ORNL's Y-12 facilities has been informally delegated to the Y-12 industrial hygienist. Since the laser safety procedures in use at ORNL and Y-12 differ somewhat, this may account for some of the inconsistencies. The use of the lasers, other than those used in interferometers, appears to be spasmodic and somewhat unpredictable; however, it is expected their use and number will increase. A simplified laser registry (similar to the registry ORNL has for X-ray equipment) with routine follow-up would facilitate the surveillance of laser activities on a more formalized basis.

In addition it would appear that the increasing demands being made on the Y-12 industrial hygiene staff's time by the current expansion at Y-12 may result in reduced coverage of ORNL's activities as informally agreed upon. It is, therefore, recommended that management review the informal delegation of industrial hygiene responsibility and consider formalizing this agreement.

B. Environmental Pollution

1. Air

Radioactivity released to the atmosphere at ORNL continues to be controlled to well below ORNL's operating control level of 13 curies per quarter. Monthly averages from all stacks approximate 1.5 curies, primarily 131-I. The airborne concentrations for several appropriately chosen non-radioactive cations are determined quarterly and the results continue to indicate that ORNL is not a significant contributor to the ambient environment. The gas-fired

steam plant based on fuel analysis, consumption and air flow, produces approximately 0.23 ppm SO_2 in the stack. Although the practice of open pit burning continues at this time, this source of air pollution will cease when the consolidated sanitary landfill at Y-12 is ready for use, probably in FY 1969.

2. Water

The main sewage treatment plant, located in the southwest area of the main laboratory complex, is a primary system and its effluent is discharged into White Oak Creek which provides secondary treatment before reaching White Oak Dam. It is considered highly desirable to establish the efficiency of the main sewage treatment plant to permit an evaluation of the degree of compliance with anticipated water quality standards.

The efficiency of the main sewage treatment plant should be evaluated for percent reduction in biochemical oxygen demand (BOD), suspended solids and other appropriate pollutional material and, since White Oak Creek provides secondary treatment, evaluate the total efficiency from primary plant influent to the confluence of White Oak Creek and the Clinch River.

The sanitary sewage from HFIR is disposed of through a packaged commercial sanitary waste treatment facility (activated sludge) having an efficiency of 85% for suspended solids and BOD.

All liquid process effluent leaving ORNL traverses the White Oak Creek embayment. Based on monthly samples at White Oak Dam, there are two USPHS drinking water limits exceeded on an annual average basis, carbon chloroform extract (CCE), 0.2 mg/l and phenols, 0.001 mg/l. The CCE concentration in the Clinch River above and below ORNL's outfall averages 5-7 times the USPHS drinking water limit, indicating ORNL is not a significant contributor if, in fact, a contributor at all. The concentration of phenols at White Oak Dam averages approximately 0.003 mg/l; however, ORNL is evaluating their current analytical technique to determine the validity of these results. The limit for phenols is based on taste rather than toxicity to humans or wildlife.

Waste oil from the motor pool is disposed of by burial in a controlled area; however, the disposal of used organic solvents and oil from other sources such as machine shops and diffusion pumps appears to be less well-controlled. A procedure for the collection and disposal of these wastes would improve the existing waste management program.

C. Applied Health Physics Field Surveillance

An attempt was made to update our information on the applied health physics survey organization. It seems that the current deployment of field surveyors accurately reflects the relative radiological implications of the various ORNL operations at the present time. A discussion of the procedures used to assure that the field surveyor has information adequate for him to provide advice and guidance to operating, maintenance and research personnel indicated an appreciation of the need for good communication within the applied health physics section.

Some exploratory discussion of the philosophy underlying contamination control criteria and their continuing relevance in the light of many years experience at ORNL raised the issue of prudent versus unnecessary conservatism. It is felt that most of the considerations, which initially led to presently used limits; namely, poorly contained facilities, insensitive instrumentation, inexperience and meager understanding of material toxicities, have in the past 25 years been significantly altered. Further, it is felt that introspection by ORNL in this area would be timely and, because of ORNL's unique position of leadership, would be in the interest of the atomic energy industry as a whole. It may be possible for the applied health physics group to consider initiation of controlled studies within the "field" environment which would lead toward a more conclusive definition of meaningful contamination limits. The thorough understanding of the radiological aspects of ORNL operations which the applied health physics group can bring to such a study together with the cooperation of operational groups and the support of laboratory management would provide an ideal setting for the study. Information generated by such a study would have Commission-wide application.

D. Interlock Systems for Radiation Sources

Prompted by the recent accelerator radiation exposure incident in Pennsylvania, an effort was made to appraise the status of protection interlocks on radiation producing devices having the potential for significant personnel exposure. An inspection based on a random selection of devices was made and indicated generally that acceptable controls are being incorporated. Isolated instances were noted; however, which suggested that ORNL's internal audit program should be strengthened. In this regard, efforts were already underway to have the Hot Cells and Sources Committee review the interlock systems on the 3 and 5.5 Mev Van de Graaff machines at Building 5500. This system incorporates an interlock bypassing feature which may be employed at the operator's discretion. It seems advisable that the potential hazard levels at which this type of control is acceptable should be decided based on review by an independent committee.

The registration and inspection of X-ray devices by the Applied Health Physics Section was reviewed. This program, as documented in the Health Physics Procedure Manual, is quite comprehensive. It did not appear that the program had yet achieved the level of implementation intended; however, effort in this direction is continuing. It is felt, in particular, that in the area of inspection, additional emphasis is warranted.

E. TRU Facility

A review was made of the recently constructed TRU facility. Operating experience has been without serious incident and containment of the high hazard transuranium material has, for all practical purposes, been absolute. Conscientious health physics coverage of work areas was evidenced and the total program of health protection is quite effective. As additional operating experience is gained, it would be appropriate to review the routine precautions to examine their utility and assure that they are not unnecessarily restrictive.

It is noted that the efficiency of the TRU charcoal filters for iodine is well below the normally expected level. This has resulted in no unacceptable release of iodine; however, the laboratory is studying the phenomenon in an attempt to identify the cause of the reduced efficiency.

Various operations are conducted at this facility in which flammable liquid and gases are utilized in both cells and glove boxes. Procedures limit the quantity of flammable liquid in a glove box to one pound. In the cells there may be a maximum of 100 pounds of solvent at one time. Explosive concentrations in the cells and glove boxes are prevented primarily by providing a high air movement and occasionally by providing an inert atmosphere in the glove boxes.

The cells and other building areas are provided with sprinklers and the glove boxes are reviewed for and equipped with protection when the use of more than one pound of flammable liquid is expected. The facility is manned at all times. This facility has operated without an incident for about 18 months and it appears the fire and explosion hazards have been minimized through administrative and engineering controls.

F. Criticality Safety

During the year there was an increase of thirty requests for nuclear safety review to a total of 140. However, some of these were renewals of expired approvals. In general, the requests appear to be more complete so that delays in obtaining approval from the Criticality Review Committee (CRC) are minimized. All operations having criticality implications are covered by current approvals.

The principal efforts of the CRC have been directed toward the SORA Reactor Critical Experiments in 9213. However, considerable CRC effort also involved the TRUST Facility at the 3019 Pilot Plant and the preparation of 40 kg. U-233 into MSRE fuel in the new TURF Facility. The TRUST Facility involves the long term storage of 1200kg. of

uranium (75% U-235 and 11% U-233) as uranyl nitrate solution in a shielded 5,000 gallon tank packed with borosilicate glass raschig rings. Back up soluble neutron absorbers as nitrates of gadolinium and samarium will also be added. Sufficient neutron absorption due to any one of the three absorbers will be provided so that the k_{oo} of the system will be less than 1. These operations are scheduled for early CY 1968.

Annual audits by the CRC of laboratory operations having current approvals revealed no deviations. These audits, which are assigned by the chairman, are made by the subcommittee. Assignments are rotated on an annual basis so that each member has an opportunity to become familiar with all pertinent operations.

The fissile inventory in various facilities appears to have increased. Part of this inventory increase is reflected in new fuel elements for reactors such as the HFIR and ORR. There have also been increases in U-233 and Pu due to program requirements. In other facilities a significant portion of the inventory does not appear required for active projects. Due to costly fabrication, etc., as well as the possibility of requiring the material for future projects, the experimenters are reluctant to release the material. The lack of a centralized storage facility, which results in this material being stored in the operating areas,continues to be of nuclear safety concern. While no immediate hazard was noted, the nuclear safety position would be improved if centralized fissile materials storage were provided to minimize the nonactive materials storage throughout the plant. A continuing review of inventory requirements by experimenters in their areas appears warranted.

ORNL continues to diversify its operation which, in many cases, has significant quantities of fissile materials and rather complicated controls for nuclear safety. During previous appraisals, the need for a full time staff nuclear safety member has been discussed. In view of current ORNL operations, it is again suggested that ORNL review this need.

G. Transportation

Five ORO approvals of ORNL radioactive materials shipping containers under AECM-0529 were issued during CY 1967. Ten requests for approval were pending with approximately fifteen additional requests currently scheduled to be submitted to ORO before June 30, 1968.

The principal problems involving transport resulted from the issuance in June 1967 of IAD-0529-16, which required that overseas shipments involving Type "B" packages and most large source shipments be made on the basis of certification by the U.S. competent authority (DOT) that IAEA standards were met. Effectively, this required a DOT special permit. Most of the ORNL containers have valid B of E permits for domestic shipments until June 30, 1968. However, they had not been reevaluated under AEC-0529 and thus had no DOT permits. This necessitated obtaining exemptions from the IAD in order to make those shipments which had been previously negotiated. With the appropriate notification to the foreign customers that radioisotopes shipments could be made only in customer-supplied certified containers until appropriate approvals were obtained for ORNL containers, the temporary delay in shipments was resolved. Subsequent approvals have also helped to alleviate the problem.

At the request of ORO, ORNL submitted a schedule for requesting approval of shipping containers. In general, the schedule for submission is being maintained. Coordination for all container approvals is made through the Isotopes Division.

This review was conducted by a team consisting of:

Jerome F. Wing for Industrial Hygiene.

Wiley A. Johnson and William A. Pryor for Nuclear Safety.

William T. Thornton and Franklin E. Coffman for Radiation Protection.

Howard V. Heacker

Howard V. Heacker
Health Physicist
Health & Nuclear Safety Branch

UNITED STATES
ATOMIC ENERGY COMMISSION

OAK RIDGE OPERATIONS
P.O. BOX E
OAK RIDGE, TENNESSEE 37830

ROUTE: M.E.R.

IN REPLY REFER TO: OSR:JBL

CR AREA CODE 615
TELEPHONE 483-8611

May 17, 1968

Cys fwd to:
R. G. Affel
F. R. Bruce
J. A. Cox--Pls handle.
5/27/68

Union Carbide Corporation
Nuclear Division
Post Office Box X
Oak Ridge, Tennessee 37830

Attention: Dr. A. M. Weinberg, Director
Oak Ridge National Laboratory

Subject: ANNUAL REACTOR SAFETY APPRAISAL OF THE ORR, LITR, BSR, AND PCA, APRIL 4, 1968

Gentlemen:

Enclosed are six copies of the report covering the ORO reactor safety annual appraisal of the subject reactors.

The appraisal committee finds that these reactors are continuing to be operated safely. However, they have offered for your consideration two recommendations, listed on page 2 of the report.

It is requested that I be informed by June 29, 1968, what actions have been taken or planned in response to the recommendations.

The cooperation extended by your staff during the appraisal is appreciated.

Very truly yours,

Herman M. Roth
Director
Laboratory and University Division

Enclosure:
Subject Report (6)

cc: C. E. Larson, UCC-ND, w/encl.
R. C. Armstrong, w/encl.
J. A. Lenhard, w/encl.

ORIGINAL

USAEC-ORO

Reactor Safety Appraisal

of the

ORR, LITR, BSR, and PCA

April 4, 1968

A. Purpose and Scope

A committee consisting of three members of the ORO Safety Division performed an annual reactor safety appraisal of the four ORNL reactors which are being operated as a reactor complex: the ORR, LITR, BSR, and PCA. The committee members were: J. B. Lingerfelt (Chairman), K. E. Elliott, and W. T. Thornton.

The appraisal was performed via discussions with the ORNL personnel and a relatively comprehensive inspection of the facilities.

The on-site appraisal was performed on April 4, 1968. The committee was aided by the following ORNL personnel.

R. G. Affel, Safety and Radiation Control Department
F. T. Binford, Superintendent, Development Department
J. A. Cox, Superintendent, Operations Division
W. M. Tabor, Supervisor, Reactor Operations Department

B. Summary

It is concluded that the reactors reviewed continue to be operated safely. The committee believes, however, that it would be beneficial if the ORNL internal review system adhered more closely to a concept of annual reviews for operating reactors, including the smaller reactors.

Safety analysis reports for the ORR and LITR have been issued in the first quarter of 1968. The two supporting documents (plant descriptions) are in the final printing stage and are scheduled to be issued by July 1968. These documents are in response to a recommendation resulting from an ORO Reactor Safety appraisal in August 1966.

Temporary tags had been used for reactor system valve identifications while permanent tags were being made. The permanent tags had not been attached to the valves in the ORR heat exchanger pit and the temporary tags were missing or the printing obliterated. The reactor supervisor gave assurance that permanent tags would be attached to all reactor system valves.

Housekeeping was found in good order, except for two instances of protective clothing which had not been picked up after workers had left the work sites. The two work sites were at the cell ventilation filter house and the heat exchanger pit. The committee was assured this is not standard practice and the situation would be remedied.

The poor condition of the insulation on the ORR primary system piping which is exposed to the weather behind the pumphouse was noted. It is believed prudent to examine this piping to establish that wet insulation does not present an unacceptably hostile environment for the piping.

C. Recommendations

1. It is recommended that ORNL establish a repetitive time interval within which a formal review of each operating reactor will be made by an ORNL review group (see section D.1.).

2. It is recommended that the acceptability be assured for the weathered insulation on the ORR primary system piping (see section D.10.).

D. Findings

1. Internal Reactor Safety Appraisals

It has been previously understood that ORNL policy is to perform a reactor safety appraisal of the operating reactors on a yearly

basis. This policy has been carried out reasonably for the ORR although an appraisal was not made during calendar year 1967 following an appraisal in December 1966.

It is noted, however, that a documented appraisal has not been performed for the LITR and BSF since December 1965. This amount of time between appraisals cannot be construed as following a policy of yearly appraisals.

Although it is recognized that the LITR and BSF operations have had scrutiny by other than operating personnel during the time between formal appraisals, it is recommended that ORNL establish a time interval within which a formal appraisal must be made regardless of whether or not a problem prompts the appraisal.

2. Training

Initial operator and shift engineer training is carried out for these reactors on a semi-individual tutorage basis. Formal tests consisting of oral, written, and physical operation of the console are required before certification is formalized. Training and certification is carried out separately for each reactor even though one individual may become certified for more than one reactor. If a certified individual is to operate a reactor but has been away from the operating environment for more than three months, a tutored review is provided before he is allowed to accept responsibility for reactor operation.

During the past year, one member of the ORO reactor safety branch has undergone reactor operations training at the ORR. Conversations with this trainee strengthens the committee's belief that the training for operation of these reactors is competent and effective.

3. Modified Shim Rod for the ORR

ORNL has contemplated a new design of the ORR shim rod featuring a reversible and replaceable fuel section in order to accomplish budgetary savings. Although the economic advantage of this design change appears less promising than previously, work is continuing to establish the characteristics of a new design. In any event, the new design will be considered a significant design change and submitted to the AEC for concurrence before being installed in a live core.

4. ORR Reactor System Piping

Portions of the primary system aluminum piping is embedded in the pool wall concrete and underground thus rendering it uninspectable. Failures have occurred in the aluminum piping of the pool cooling system where it has come in contact with concrete or grouting. Because of the pool cooling system failures, some of the pool cooling system piping has been rerouted since it carries a very low level of radioactivity. The embedded primary system piping is used because of the need for shielding of short-lived and a vacuum system was installed to hold a vacuum between the pipe and concrete in the pool wall thereby monitoring for leaks. The vacuum system condensate has been monitored for a 24-hour period each month for about five years with the effluent measuring randomly between 5 and 60 milliliters per hour.

Although a leak in the primary system would represent a major operational problem, the reactor system could tolerate a primary system leak without jeopardizing the integrity of the core.

5. Negative Differential Worth of Control Rod

Rod worth measurements have indicated that the two ORR control rods

having the highest worth exhibit negative incremental worth near their fully withdrawn position (approximately the last inch). This is not a newly recognized characteristic and has been reported by other groups operating reactors with fuel following poison control elements.

The phenomenon is explained by the fact that, as the fueled section of the control element is completely inserted into the core (as poison is removed), fuel is removed from the higher flux region promoted by reflector savings. This results in a reactivity decrease.

In order to assure that negative reactivity is inserted monotonically after a scram, the limit switches have been set to limit control rod poison withdrawal so that insertion of poison (and simultaneous movement of the fueled section) always results in decreasing core reactivity.

The appraisal committee agrees with this action.

6. Cadmium Contamination of ORR Primary System Water

Immediately following a refueling shutdown in October 1967, an increase in primary water radioactivity occurred. The radioactivity was found to originate from the cadmium section of a control rod. Examination of the rod after the outer cladding was removed indicated that some water channeling had taken place between the cladding and the cadmium. A small amount of corrosion or erosion had occurred at the bottom of the cadmium sheet. This section of the rod is vented at the lower end. Development of a small cladding flaw at the upper end can permit water channeling under the cladding and sweep loose particles into the primary water.

This occurrence, although undesirable from an operating point of view, is not believed to represent an incipient significant safety problem.

7. Documentation

Following the ORO appraisal of these facilities in August 1966, the appraisal committee recommended that reactor safety analyses reports be prepared for the ORR and LITR. A comprehensive report had never been prepared covering the operational safety of the LITR. The report for the ORR was not applicable to present day operation.

A safety analysis report for the LITR was published in February 1968 and one for the ORR was published in March 1968. Drafts for two accompanying documents describing these two reactors have been completed. ORNL estimates that these descriptive documents will be completed in published form by the end of June 1968.

The published safety analysis reports conclude that operation of these reactors do not present an undue hazard to the health and safety of the public and contain reasonable arguments for this conclusion.

8. Drawing Revisions

Members of the ORNL I and C division, the General Engineering division, and the Operations division were contacted for discussions on the means by which facility drawings are kept up to date.

The reactor instrumentation and control drawings are revised based upon work authorized and performed under a "change memo" system and under a general "work order" system. Smaller changes are described and approved on a change memorandum before the change is made. The

"change memo" system supplements the more general "work order" system to control the smaller changes which require only incidental amounts of labor but can produce a significant operational change. Change memos are coordinated through (usually originated by) the person responsible for drawing revision. Larger jobs requiring significant amounts of labor are done under a work order system wherein the design is recorded and approved in the form of a finished drawing.

Power distribution and general engineering changes are accomplished through the work order system wherein the drawing is usually completed prior to performing the work.

A cursory review of the contents of some of the drawings indicated that the revision system is effective and the working drawings are in a usably up-to-date condition.

9. LITR Status

It was reported that the operation of the Low Intensity Test Reactor has not been funded for FY 1969. It is to be expected that the LITR will be placed in a defueled stand-by condition during the summer of 1968. The appraisal committee was asked if there would be formal activities required to restart the reactor if the need developed. ORNL was informed that the ORO Safety division would want to perform a preoperation review following a prolonged period of shutdown. It was agreed that the ORO Safety division would be kept informed and no attempt was made to define a "prolonged period" of time.

10. Tour of the Facilities

The appraisal committee spent considerable time inspecting the buildings and equipment of these reactors.

It was noted that general housekeeping was at a very acceptable level. There were, however, two locations at which protective clothing had been allowed to remain at the site after the performance of work. Soiled coveralls and plastic booties were lying on the floor in the cell ventilation filter house although no work had been performed there for a number of days. Soiled plastic booties were lying on the ground at the ORR heat exchanger pit and appeared to have been there at least overnight. The committee was assured that this was not standard practice and that steps would be taken to remove the clothing.

Also noted was the very bad condition of the insulating material covering the primary coolant bypass filter piping which is exposed to the weather in back of the ORR pump house. Although this condition may seem insignificant when compared to piping actually buried in concrete or earth, there is some possibility that wet insulation could provide an even more hostile environment to the piping. It was suggested that this possibility be investigated.

The 1965 ORO reactor safety appraisal noted that some of the reactor system valve identification tags were missing. Subsequently, identification tags were attached to the reactor system valves. Some of these tags could not survive their environment and were considered temporary until permanent tags could be made. It was noted during this appraisal that the permanent tags had not been attached to valves in the ORR heat exchanger pit and the temporary tags were missing or obliterated. The reactor supervisor gave assurance that permanent identification tags would be attached to all reactor system valves.

J. B. Langerfelt (Chairman)

for K. E. Elliott

W. T. Thornton

UNITED STATES
ATOMIC ENERGY COMMISSION
OAK RIDGE OPERATIONS
P.O. BOX E
OAK RIDGE, TENNESSEE 37830

CR

AREA CODE 615
TELEPHONE 483-8611

IN REPLY REFER TO:

OSR:KEE

August 9, 1968

Cys fwd to:
R.G.Affel
F.R.Bruce
J.A.Cox
M.E.Ramsey
E.G.Silver
8/15/68

Union Carbide Corporation
Nuclear Division
Post Office Box X
Oak Ridge, Tennessee 37830

Attention: Dr. A. M. Weinberg, Director
Oak Ridge National Laboratory

Subject: REACTOR SAFETY APPRAISAL OF THE HFIR, MAY 27-28, 1968

Gentlemen:

A reactor safety appraisal of the HFIR operations was conducted on May 27-28, 1968, by an appraisal committee from the ORO Safety Division. A draft report from the committee was reviewed by ORNL Operations Division and their comments were considered in the preparation of the final report.

Enclosed are six copies of the formal appraisal report. No specific recommendations are made; however, the summary and actions concerning a previous recommendation should be noted. Your comments, if any, on the conduct of the appraisal and the general content of the report are invited.

Originally, it was intended that a section of the appraisal report would cover HFIR operating limits; however, our discussions with the Operations Division concerning these limits have not yet been completed. We, therefore, decided not to hold up the issuing of the Safety Appraisal Report to include this additional section. A separate letter covering our comments on HFIR operating limits, if any, will be sent to you at a later date.

The cooperation extended by ORNL during the appraisal is appreciated and we are pleased that the report reflects continued safe operation of the HFIR.

Very truly yours,

Herman M. Roth

Herman M. Roth
Director
Laboratory and University Division

Enclosure:
Subject Appraisal Report (6)

cc: C. E. Larson, UCC-ND, w/encl.
R. C. Armstrong, w/encl.
J. A. Lenhard, w/encl.
W. O. Mickelson, e/encl. (2)

USAEC-ORO

Reactor Safety Appraisal

of the

High Flux Isotope Reactor

May 27-28, 1968

I. Purpose and Scope

An annual reactor safety appraisal was made at the High Flux Isotope Reactor at Oak Ridge National Laboratory on May 27-28, 1968.

II. Summary

The safety appraisal was performed by members of the Reactor Safety Branch and the Health and Nuclear Safety Branch, Safety Division, ORO. These members included:

K. E. Elliott, Reactor Safety Engineer, Chairman
R. E. Harris, Reactor Safety Engineer
J. B. Lingerfelt, Reactor Safety Engineer
W. T. Thornton, Health Physicist

ORNL personnel of the Operations Division, the Instrumentation and Controls Division, and the Metals and Ceramics Division who were contacted included:

R. G. Affel, Safety and Radiation Control Department
F. T. Binford, Development Department Superintendent, Operations Division
J. B. Bullock, Instrumentation and Controls Division
C. D. Cagle, Technical Assistance Department Superintendent, Operations Division
J. A. Cox, Operations Division Superintendent
R. V. McCord, HFIR Reactor Supervisor, Operations Division
R. T. King, Metals and Ceramics Division
A. L. Lotts, Metals and Ceramics Division
L. C. Oakes, Instrumentation and Controls Division
T. M. Sims, Technical Assistance Department, Operations Division
J. E. VanCleve, Metals and Ceramics Division

Operation of the HFIR has been relatively smooth during the past year with the exception of a control plate bearing problem. The Reactor Safety Branch has prepared a separate safety appraisal of the control plate bearing problem (see Reference 1). ORNL now believes that this problem has been resolved satisfactorily with the newly designed bearing lugs. Investigation of the HFIR target rod failures has been continuing by the ORNL Metals and Ceramics Division, and the appraisal committee discussed these investigations with members of the Metals and Ceramics Division. The HFIR computer has been installed and is now undergoing checks and tests to assure that its performance is adequate.

In addition to the items mentioned above, other safety related topics were discussed with ORNL personnel. These topics included organization and training, procedures, previous recommendations, emergency equipment, reports and checklists, and instrumentation changes. The operating limits will be discussed in more detail at a later time to determine if they are consistent and up-to-date with respect to present operation.

The committee was impressed at the continued high level of competence and the good safety attitude of the HFIR operations personnel. We have concluded that the HFIR is being operated in a safe and organized manner.

III. Recommendations

The appraisal committee has no recommendations.

The previous recommendation from the ORO Safety Review of May 18-19, 1967 (see Reference 2), concerning visitor control policies at HFIR, has not yet been completely resolved; however, substantial progress has been made. At present, a gate has been provided at the entrance to the HFIR-TRU area near the MSRE Facility. A guard is on duty at the gate during the day shift, but the entrance is uncontrolled during night and weekend shifts.

The gate is now being motorized so that controlled access during the night and weekend shifts will be available. There will be two modes of entry whenever the guard is not on duty. These will include:

1. A telephone nearby will permit the visitor to talk with ORNL guard headquarters. He will be admitted if he can assure guard headquarters that he is on official business.

2. Government vehicles which are frequently used in the area on shift (and also emergency vehicles) will be provided with garage door remote opener controls which can open the gates. An indicator light in the guard headquarters will indicate when the gate is open.

The appraisal committee believes that the response to this recommendation, when implemented as described, will be satisfactory.

IV. Findings

A. Organization and Training

The operating organization at HFIR remains essentially the same as shown in figure 1 of the USAEC-ORO Reactor Safety Review of HFIR, May 18-19, 1967 (see Reference 2). One of the shift engineers, C. A. Sweet, has been replaced by W. R. Hobbs. There are now fifteen qualified operators at HFIR.

Part 55 of the Code of Federal Regulations, Chapter 10, is followed in the training and qualification of operators and shift engineers. Biennially, each operator's qualifications are reviewed and a statement is placed in his file that he remains qualified. There is no special training of operators required for the computer operation at this time. Its programs are fixed in the machine and cannot be changed at the reactor console.

B. Procedures and Emergency Plans

The only major procedures change during the past year has been a complete updating of annunciator procedures. Other procedures remain essentially the same as previously described. Special operating procedures, which were used often during the startup and checkout of HFIR, are becoming much less frequent.

The last daytime emergency drill at HFIR was held in May 1968, and during this drill, all persons evacuated the buildings. The evacuation horns are tested weekly during night or weekend shifts. Any local emergency which might affect HFIR personnel, such as an emergency at MSRE or NSPP, would probably be announced over the Laboratory public address system which is used to give instructions or information to the whole ORNL complex. Telephoning to the HFIR Facility would be a secondary method of informing HFIR personnel of such an emergency. HFIR personnel would need information in such an emergency in order to determine which direction to evacuate the area. The reactor can be scrammed or shut down and abandoned during an emergency without significant safety concern.

C. Emergency Equipment

The appraisal committee discussed the testing of emergency equipment with operations personnel. Two emergency diesels, one electrically started and the other pneumatically started, are tested for starting each week. To date there have never been any problems in starting these diesels. Each set of instrumentation batteries for emergency use is checked with a resistance load at about four-month intervals. One pony motor battery bank is tested each shutdown

period by operating the pony motor with the battery charger disconnected. Each battery bank is also tested at about four-month intervals. The battery banks are designed to supply power to the pony motors for at least two hours even in the unlikely event that the diesel generators fail to start.

Testing of charcoal filters for efficiency in retaining radioactive iodine was recently completed. Efficiencies of all filters were better than 99% for elemental iodine. The filters were also checked for retention of methyl iodide although acceptable efficiency values have not yet been established. This is due to moisture in the charcoal having a pronounced effect on methyl iodide retention efficiencies.

The secondary shutdown system (or poison injection system) is tested about twice per year. During this test, all valves are checked to assure that they can be opened, but solution is prevented from entering the primary system by means of two series valves with a vent line between them. One of these valves is tested and the vent line observed while the other valve is closed, then the second valve is tested while the first valve is closed.

Although there are tests of other emergency equipment, the appraisal committee believes that the equipment discussed above is the most significant from a safety viewpoint. The committee believes that there is a satisfactory testing program for emergency equipment at HFIR.

D. Control Plate Bearing Problem

There have been no recent developments in the control plate bearing problem and the committee believes the conclusion of the USAEC-ORO Reactor Safety Appraisal of January 8, 1968 (Reference 1) is still valid. This conclusion is that ORNL is proceeding with the

operation of HFIR in a prudent manner with ample regard for safety. Although it has not been shown that the problem is completely resolved, the committee believes that substantial progress has been made toward resolving the problem.

New bearing lugs are now in use on the reactor control plates and have been examined twice since being placed in service. As a result of these examinations, the lugs appeared to be in good condition; therefore, the decision was made to continue using them. They are significantly more massive and stronger than the ones that failed. Other bearing lugs which are the same design as those now being used in the reactor are being tested on a special test set-up at ORGDP. These lugs have withstood more than 10^8 fatigue cycles with no observable effects. This is more than a factor of 10^2 greater than the fatigue cycles which caused the original design lugs to fail.

E. Target Rod Failures

During the past year, the Metals and Ceramics Division at ORNL has been involved in an intensive study of the severe radiation damage to aluminum alloys (see Reference 3). This study was initiated because of the damage to HFIR target rods and to ORR core components. The committee was given an informative briefing by members of the Metals and Ceramics Division relating to the HFIR target rod failures.

The cause of target rod failures is presently believed to be due to the radiation embrittlement of the aluminum cladding and the buildup of fission gas internal pressure under the cladding. Radiation embrittlement is caused by helium formation from the n,α reaction with aluminum; hydrogen formation from the n,p reaction

with aluminum; and silicon buildup as a result of the n,γ reaction with aluminum. Average neutron exposure of the failed target rods was about 3×10^{22} nvt (thermal), and 1×10^{22} nvt (fast). The virgin rods now in the reactor (rods which have not been preexposed in the Savannah River Reactors) have experienced about 45-50% burnup with no indication of failure. Most of the new target rods have the same fuel loading per pellet as the original ones (8 grams of ^{242}Pu), but the density of the aluminum-actinide oxide matrix of the pellets has been decreased. This should allow more fission gas buildup before pressure can increase to the cladding failure point. Several test rods having 6 grams of ^{242}Pu per pellet are now being irradiated.

The committee believes that ORNL progress in the resolution of this problem has been satisfactory and notes that further studies of aluminum irradiation are now in progress at ORNL. In case of failure of the target rods now in the reactor, there should be adequate indication from alpha activity in the primary coolant system before a significant safety concern could develop.

F. Reactor Core and Experiments

Recently, during a beginning of cycle startup, a small increase in reactivity was noted by the slight insertion movement of control plates. This was attributed to a small xenon effect in the target rods. The magnitude of this effect is about 25¢ in reactivity and is not considered a safety concern by ORNL. The committee agrees with the ORNL conclusion.

Because of the possible safety implications in the use of plastics around reactor cores, especially one such as HFIR, the committee discussed the policy with regard to use of plastics at HFIR. No clear plastics are used in the core region of the reactor pool during core manipulations. The committee noted during the tour

of the facility that most of the plastics used at the facility are the colored type which would make them visible in case they inadvertently fell into the pool.

Presently, three of the horizontal beam tubes are in use. Neutron diffraction studies are being performed at all three of these beam tubes. Two of these experiments were reviewed in detail by the RERC, but the third was so similar to the first two that it did not receive the detailed RERC review. Another neutron diffraction experiment is being set up at the fourth horizontal beam tube. Only one engineering facility tube is now being used. It contains a chamber for the Instrumentation and Controls Division to study noise analysis in the HFIR core.

G. Reports and Records

Revision 2 of ORNL-3572, "The High Flux Isotope Reactor, A Functional Description," Volume 1A, dated May 1968, was recently completed and issued by ORNL (see Reference 4). Volume 1B, which includes illustrations, should be issued during this summer. These documents, along with the Accident Analysis Report, which was issued in April 1967 (see Reference 5), will make up a complete up-to-date Safety Analysis Report for HFIR.

Instrumentation drawings are kept up-to-date by a "change memo" system and a general "work order" system which are similar to the systems described in the most recent Reactor Safety Appraisal for the ORR, LITR, BSR, and PCA (see Reference 6, section D-8). Recently, a mechanical change memo system has been initiated for directly related safety items such as the control plate bearing lug changes. The committee was pleased to note that this system is now in use.

During the tour of the facility, the committee examined several of the HFIR operating records. These included log books, startup and shutdown check lists, instrumentation and mechanical change memos, special operating instructions, reactor water record, operating procedures, work orders, nuclear instrument set points, the rod worth data book, and the shutdown schedule. A cursory review of these documents indicated that satisfactory records are kept of reactor operations and changes.

H. Radiological Safety

Radiation and contamination control appear to have been maintained at a satisfactory level. One unusual occurrence was noted involving a high radiation alarm. The building evacuation horn actuated because the radiation level exceeded 23 mr/hr on two monitors during the movement from one pool to another pool of a new, nonradioactive control plate with a used, radioactive coupling. No personnel exposure of significance was sustained. In general, personnel exposure levels continued to be commendably low. Routine radiation safety surveillance required by the increasing use of the HFIR Beam Tube Facilities for experiments appeared to be recognized. Essentially, all of one man year health physics effort is now given exclusively to HFIR activities. The committee concludes that radiological safety aspects at the HFIR facility are satisfactory.

I. Computer Installation

Installation and checkout of the HFIR computer is nearing completion. The first usage of the computer with the reactor will involve data logging of the important operational parameters. Later, the computer will be used for startup, rod shimming, and recovery after a rod drop. It should be noted that safety action is entirely separate from computer control. The computer programs

are fixed in the machine and can only be changed with great effort and knowledge of the system. This assures that undesirable instructions will not be fed into the computer. The computer will not require any assistance from the operator, but the operator has the option of disconnecting the computer from the system at any time by means of a switch on the console. A more thorough review will be performed by both ORNL and ORO prior to the computer operation of HFIR.

A checkout of the computer shimming operation was recently made during a special test. The test was successful and the computer trip program checked out satisfactorily. This test was reviewed prior to its performance by the Technical Assistance Department and the Development Department of the Operations Division. In addition, a change memo was issued for this special test and a special test procedure was prepared by the Supervisor and Assistance Supervisor of the facility. The committee believes that the safety aspects of the test were adequately reviewed by ORNL.

K. E. Elliott
K. E. Elliott, Chairman

R. E. Harris
R. E. Harris

K. E. Elliott /for
J. B. Lingerfelt

W. T. Thornton
W. T. Thornton

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1. USAEC-ORO Reactor Safety Appraisal of the HFIR Control Plate Bearing Problem, January 8, 1968.

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3. Severe Radiation Damage to Aluminum Alloys, compiled by J. E. Cunningham, ORNL-TM-2138, March 1968.

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5. The High Flux Isotope Reactor Accident Analysis, ORNL-3573, April 1967.

6. USAEC-ORO Reactor Safety Appraisal of the ORR, LITR, BSR, and PCA, April 4, 1968.